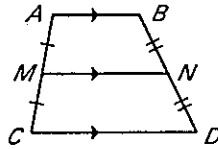


|           |                                    |
|-----------|------------------------------------|
| CRS       | PPF701 Classify quadrilaterals     |
| Objective | 12.7 Find the area of a trapezoid. |

→ Add “find midsegment” and “area of trap” to “Classifying Quads” each day.

The midsegment of a trapezoid is parallel to each base and its length is one half the sum of the lengths of the bases.



If  $\overline{MN}$  is the midsegment of trapezoid  $ABCD$ , then

$$\overline{MN} \parallel \overline{AB}, \overline{MN} \parallel \overline{DC}, \text{ and } MN = \frac{1}{2} (\overline{AB} + \overline{CD}).$$

\*Note that midsegment is the same as median

Area of trap:  $\frac{1}{2}(b_1+b_2)(h)$

→ Show kids derivation of area of a trap formula @ - you pick which one you want to use:

<http://www.mathopenref.com/trapezoidareaderive.html>

**Or this:** The area of a trapezoid is calculated by an interesting formula that we have already discussed in a Khan video.

<http://parkerkhantest.appspot.com/video/area-of-a-trapezoid?playlist=Developmental%20Math>

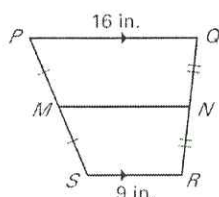
→ Have kids talk about this! They will synthesize in the CW

Name: \_\_\_\_\_ TP: \_\_\_\_\_

|           |                                    |
|-----------|------------------------------------|
| CRS       | PPF701 Classify quadrilaterals     |
| Objective | 12.7 Find the area of a trapezoid. |

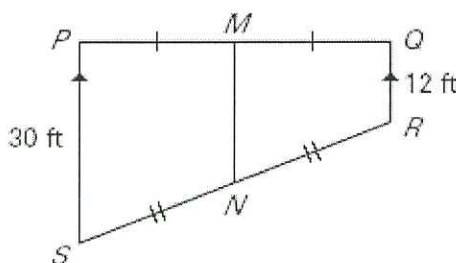
REFLECTION: Why can the midsegment of a trapezoid be calculated by averaging the two bases? Use vocabulary.

**Example 1:** In the diagram, MN is the midsegment of trapezoid PQRS. Find MN.



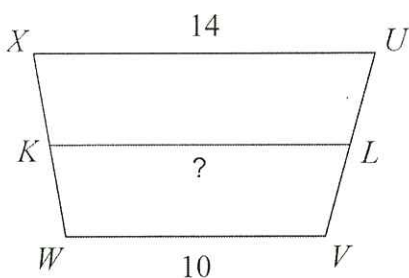
12.5 in

1) Find midsegment MN in the trapezoid.



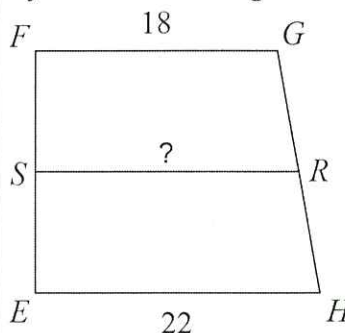
21 ft

2) Find the midsegment.



12

3) Find the midsegment.

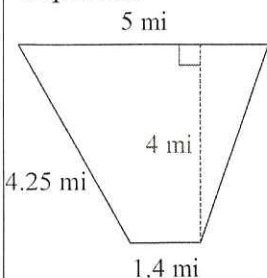


20

REFLECTION: Explain how the area of a trapezoid formula is derived. Draw a picture if it helps!

When two trapezoids are combined, the result is a parallelogram. The area of a parallelogram is  $B \cdot H = (B_1 + B_2)H$ . Since this is the area of 2 traps, you divide by 2.  
 $\frac{1}{2}(B_1 + B_2)H$

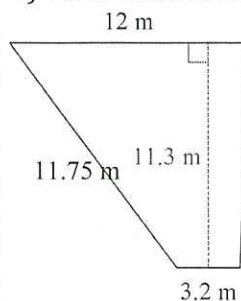
**EXAMPLE 2:** Find the area of the trapezoid:



$$\frac{1}{2}(5 + 1.4)(4)$$

12.8 mi

4) Find the area of the trapezoid:

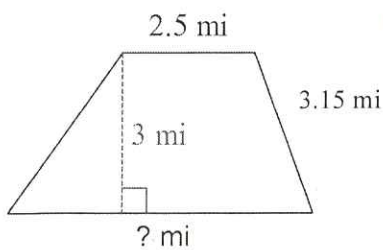


$$\frac{1}{2}(12 + 3.2)(11.3)$$

30.4 m

**PUSH IT TO THE LIMIT.**

5) Find the missing length of the trapezoid given the area.

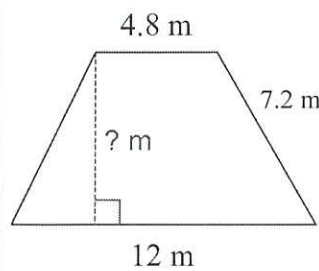


Area =  $12.3 \text{ mi}^2$

$$\frac{1}{2}(2.5 + x)3 = 12.3$$

$$x = 5.7 \text{ mi}$$

6) Find the missing length of the trapezoid given the area.

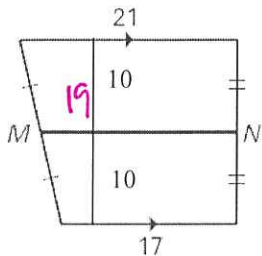


Area =  $57.1 \text{ m}^2$

$$\frac{1}{2}(4.8 + 12)(x) = 57.1$$

$$x = 6.8 \text{ m}$$

EXAMPLE 3:



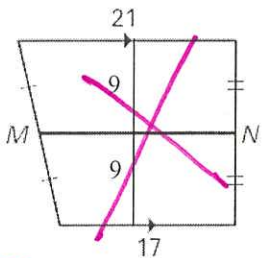
a) Find the length of the midsegment of the trapezoid.

$$\frac{21 + 17}{2} = 19$$

c) What is the area of the bottom trapezoid?

$$\frac{1}{2}(19 + 17)(10)$$

$$180 \text{ units}^2$$



b) What is the area of top trapezoid?

$$\frac{1}{2}(21 + 19)(10)$$

$$200 \text{ units}^2$$

d) What is the area of the whole trapezoid?

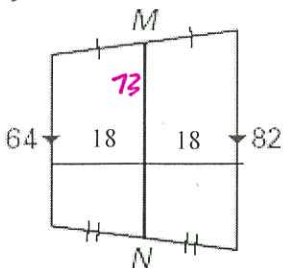
$$\frac{1}{2}(21 + 17)20$$

$$380 \text{ units}^2$$

or

$$180 + 200$$

7)



a) Find the length of the midsegment of the trapezoid.

$$\frac{1}{2}(64 + 82)$$

$$73 \text{ units}$$

c) What is the area of the bottom trapezoid?

$$\frac{1}{2}(64 + 73)(18)$$

$$1,233 \text{ units}^2$$

b) What is the area of top trapezoid?

$$\frac{1}{2}(73 + 82)(18)$$

$$1,395 \text{ units}^2$$

d) What is the area of the whole trapezoid?

$$1,233 + 1,395$$

$$2,628 \text{ units}^2$$

PUSH IT TO THE LIMIT.

8) If the area of a trapezoid is 39 square yards, base 1 is 10 yards, and base 2 is 16 yards, what is the height  $h$  of the trapezoid?

$$\begin{aligned} A &= 39 \\ B_1 &= 10 \\ B_2 &= 16 \\ H &= ? \\ 39 &= \frac{1}{2}(10+16)h \\ 39 &= 5 \cdot 13h \\ \boxed{h} &= \boxed{3 \text{ yd}} \end{aligned}$$

9) If the area of a trapezoid is 24 square inches, 1 base measures 8 inches and the height measures 4 inches, what is the measure of the second base  $b$ ?

$$\begin{aligned} A &= 24 \\ B_1 &= 8 \\ H &= 4 \\ b_2 &= ? \\ 24 &= \frac{1}{2}(8+b)4 \\ 24 &= \cancel{4} \cdot \cancel{4} \cdot \frac{1}{2}(8+b) \\ &= 2(8+b) \\ 24 &= 16 + 2b \\ \boxed{.4 = b} \end{aligned}$$

10) True or False. If false, explain why.

T or F – All squares are rhombi

T

T or F – All rhombi are squares.

F; rhombi do not all have 4 right  $\angle$ s

T or F – Diagonals are congruent in both squares and rectangles.

T

T or F – Rectangles are always parallelograms.

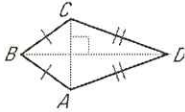
T

T or F – Parallelograms are always rectangles.

F; parallelograms do not all have right  $\angle$ s.

TEACHER NOTES - KEY

|           |  |
|-----------|--|
| CRS       | PPF701 Classify quadrilaterals                                       |
| Objective | 12.6 Use properties of kites to find missing side lengths and angles |

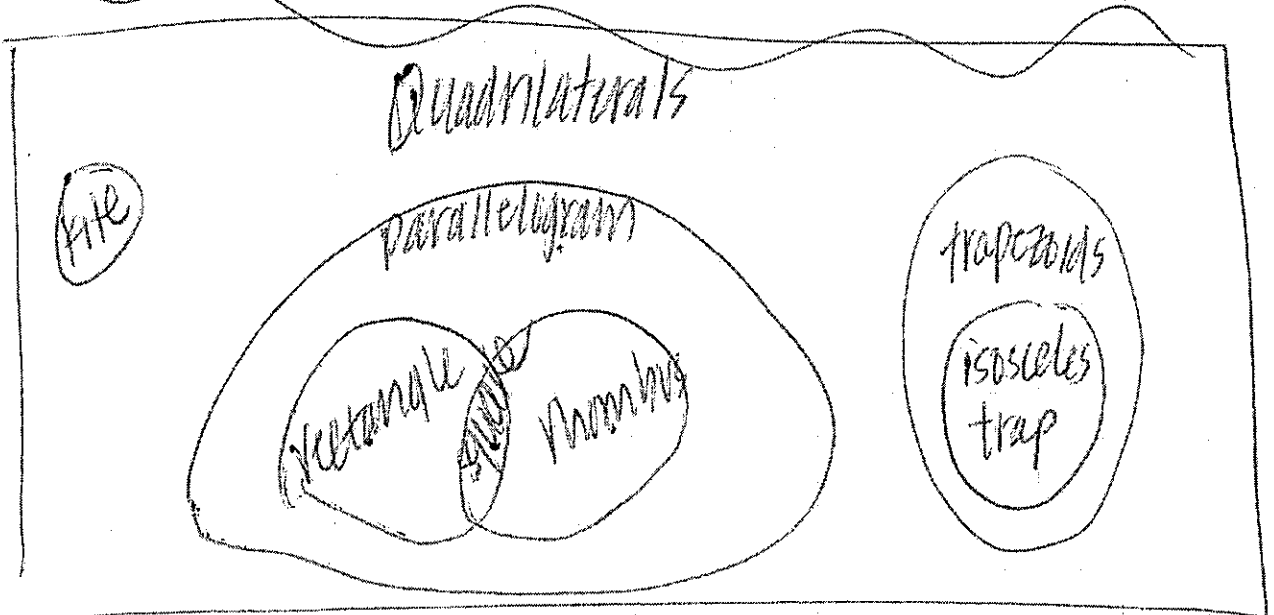
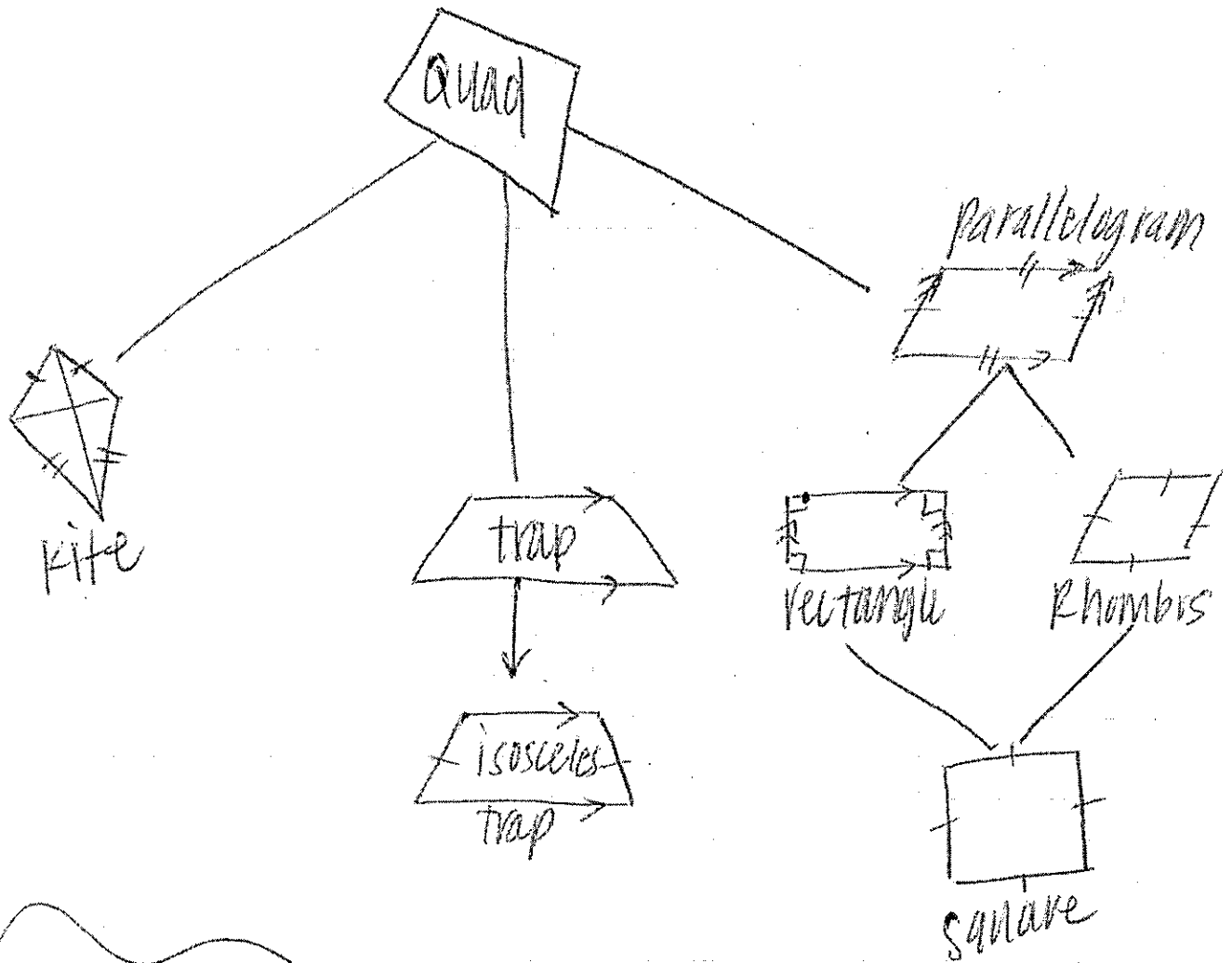
|           | Kite  |
|-----------|---|
| Picture   |  |
| Sides     | 2 pairs of consecutive congruent sides  |
| Angles    | → 1 pair of opposite angles congruent   |
| Diagonals | → Diagonals perpendicular<br>→ One diagonal bisects the other                     |

Area

Area of top  $\triangle$   
+ Area of bottom  $\triangle$



# Quadrilateral Family Tree



**PUSH IT TO THE LIMIT.**

Name: \_\_\_\_\_ TP: \_\_\_\_\_

|           |  |
|-----------|--|
| CRS       | PPF701 Classify quadrilaterals                                       |
| Objective | 12.6 Use properties of kites to find missing side lengths and angles |

**MIXED REVIEW**

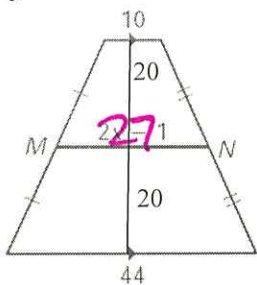
1) What is the area of a trapezoid formula?

$$\frac{1}{2}(b_1 + b_2)(h)$$

2) Explain how you find the midsegment of a trapezoid?

Average the bases

3)



a) Find the value of x.

$$\frac{10 + 44}{2} = 2x - 1$$

$$27 = 2x - 1$$

$$x = 14$$

$$2(14) - 1 = 27$$

b) What is the area of top trapezoid?

$$\frac{1}{2}(10 + 27)(20)$$

$$370 \text{ units}^2$$

c) What is the area of the bottom trapezoid?

$$\frac{1}{2}(27 + 44)(20)$$

$$710 \text{ units}^2$$

d) What is the area of the whole trapezoid?

$$710 + 370$$

$$1080 \text{ units}^2$$

4) Tell if the statement is always true, sometimes true, or never true.

A trapezoid is a parallelogram.

**Never True**

The bases of a trapezoid are parallel.

**Always**

The base angles of an isosceles trapezoid are congruent.

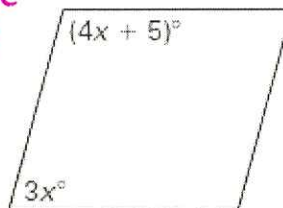
**Always**

The legs of a trapezoid are congruent.

**Sometimes**

5a) What quadrilateral is shown below?

**Parallelogram**



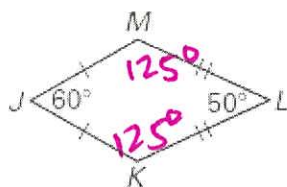
b) Find the value of x.

$$4x + 5 + 3x = 180$$

$$x = 25$$

# KITES!!!

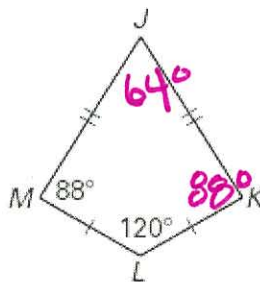
**Example 1:** Find the measurement for angles M and K.



$$360 - 110 = 250$$

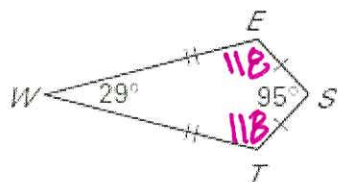
$$\frac{250}{2} = 125$$

6) Find the measurements of angle J and K.



$$360 - 296 = 64$$

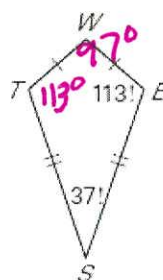
7) Find the measurements of angle E and T.



$$360 - 95 - 29 = 236$$

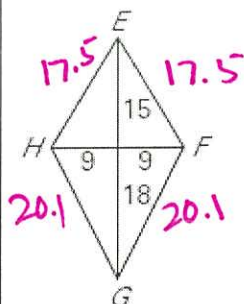
$$\frac{236}{2} = 118$$

8) Find the measurement of angle W and T.



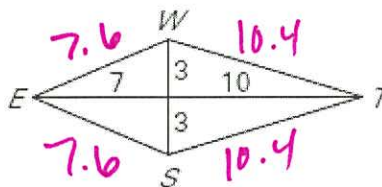
$$360 - 113 - 37 = 210$$

**Example 2:** Determine the perimeter of the kite below.



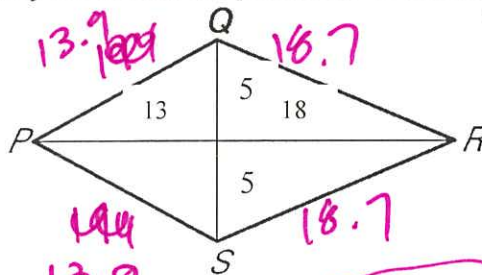
$$17.5(2) + 20.1(2) = 75.2 \text{ units}$$

9) Determine the perimeter of the kite below.



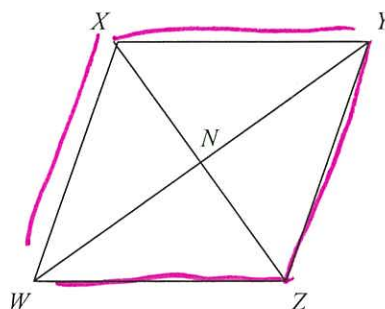
$$2(7.6) + 2(10.4) = 36 \text{ units}$$

10) Determine the perimeter of the kite below.



$$13.9(2) + 18.7(2) = 65.2 \text{ units}$$

11) Review: WXYZ is a parallelogram. Name an angle congruent to  $\angle WZY$ . MARK UP the diagram.



YXW

- A  $\angle ZXY$  B  $\angle XWZ$  C  $\angle ZXW$  D  $\angle WXY$



**TEACHER NOTES - KEY**

|           |                                |
|-----------|--------------------------------|
| CRS       | PPF701 Classify quadrilaterals |
| Objective | 12.7 Find the area of kites.   |

*Finding area of a kite:*

- *Each triangle made by the intersecting diagonals forms a right triangle*
- *Find the area of each right triangle (4 of them) and add to find total area!*

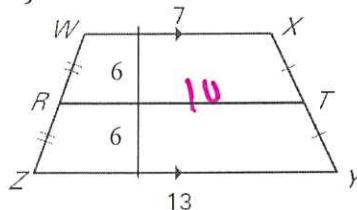
*OR Find area of top & bottom  $\frac{1}{2}$  add*

Name: \_\_\_\_\_ TP: \_\_\_\_\_

|           |                                |
|-----------|--------------------------------|
| CRS       | PPF701 Classify quadrilaterals |
| Objective | 12.7 Find the area of kites.   |

MIXED REVIEW

1)



a) Find the midsegment RT.

$$(7+13)/2 = 10$$

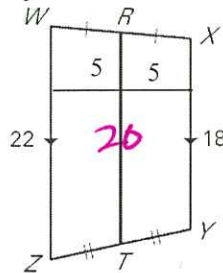
b) What is the area of WXTR?

$$\frac{1}{2}(7+10)(6) = 51$$

c) What is the area of RTYZ?

$$\frac{1}{2}(10+13)(6) = 69$$

2)



a) Find the midsegment RT.

$$(18+22)/2 = 20$$

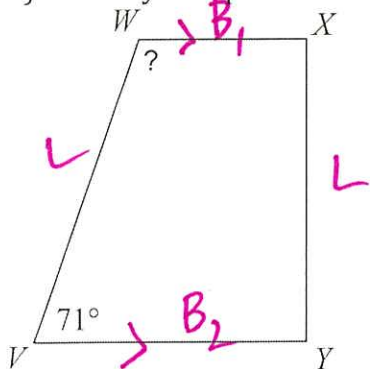
b) What is the area of XYTR?

$$\frac{1}{2}(18+20)(5) = 95$$

c) What is the area of RTZW?

$$\frac{1}{2}(20+22)(5) = 105$$

3) Identify the quadrilateral below:



a) Label the bases and legs.

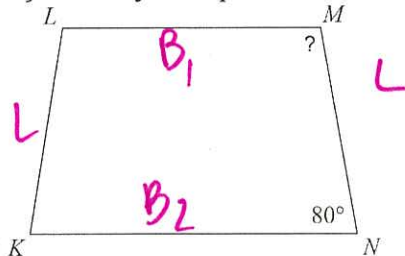
b) What angles are supplementary?

$$\angle W \text{ and } \angle X; \angle Z \text{ and } \angle Y$$

c) What is the measure of angle W?

$$180 - 71 = 109^\circ$$

4) Identify the quadrilateral below:



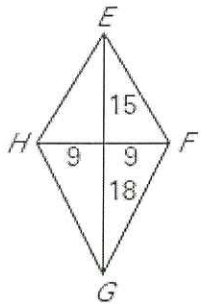
a) Label the bases and legs.

b) What angles are supplementary?

$$\angle L \text{ and } \angle K; \angle M \text{ and } \angle N$$

c) What is the measure of angle M?

**Example 1:** Determine the area of the kite below in meters.

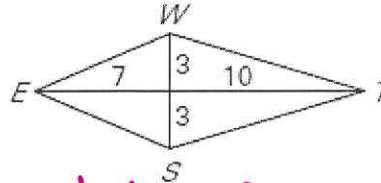


$$\frac{1}{2}(15)(18) = 135$$

$$\frac{1}{2}(18)(18) = 162$$

$$135 + 162 = 297 \text{ m}^2$$

5) Determine the area of the kite below in centimeters.

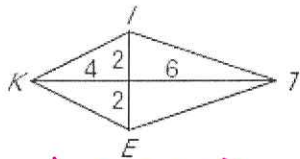


$$\frac{1}{2}(7)(6) = 21$$

$$\frac{1}{2}(6)(10) = 30$$

$$21 + 30 = 51 \text{ cm}^2$$

6) Find the area of the kite below. All units are in feet.

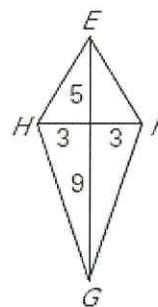


$$\frac{1}{2}(4)(4) = 8$$

$$\frac{1}{2}(4)(6) = 12$$

$$8 + 12 = 20 \text{ ft}^2$$

7) Find the area of the kite below.



$$\frac{1}{2}(5)(6) = 15$$

$$\frac{1}{2}(6)(9) = 27$$

$$15 + 27 = 42 \text{ units}^2$$

8)

The diagonals of rhombus  $WXYZ$  intersect at  $V$ . Given that  $m\angle XZY = 34^\circ$  and  $WV = 7$ , find the indicated measure.

13.  $m\angle WZV$   $34^\circ$

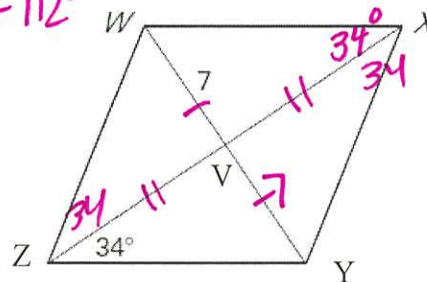
14.  $m\angle XYZ$   $180 - 2(34) = 112^\circ$

15.  $WY$   $14$

16.  $XY$   
You will need to use trig!

$$\sin 34 = \frac{7}{x}$$

$$x = 12.5$$



9)

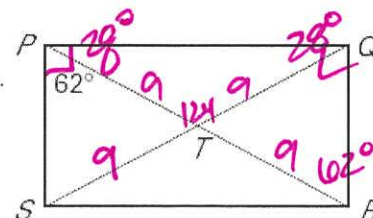
The diagonals of rectangle  $PQRS$  intersect at  $T$ . Given that  $m\angle RPS = 62^\circ$  and  $QS = 18$ , find the indicated measure.

17.  $m\angle QPR$   $28^\circ$

18.  $m\angle PTQ$   $124^\circ$

19.  $ST$   $9$

20.  $PR$   $18$



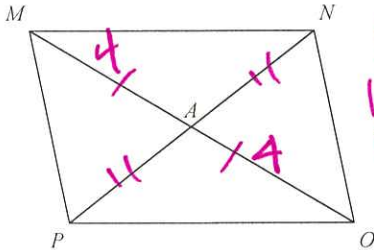


Name: \_\_\_\_\_ TP: \_\_\_\_\_

|           |   |
|-----------|---|
| CRS       | PPF701 Classify quadrilaterals  |
| Objective | 12.8 Use properties of quadrilaterals to correctly identify them, find missing sides and angles, and determine the perimeter and area of the quadrilateral. |

### WHITEBOARD TRIVIA

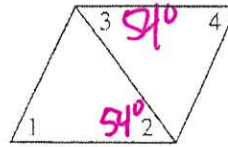
- 1) Find  $AM$  in the parallelogram if  $PN = 9$  and  $AO = 4$ .  
4. The diagram is not to scale. *Explain.*



*AM = 4  
b/c diagonals  
bisect each  
other*

2)

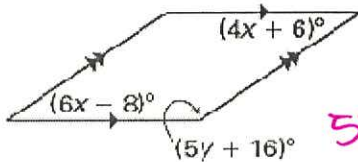
In the parallelogram below, a diagonal is shown and  $\angle 2$  measures  $54^\circ$ . What is the measure, in degrees, of  $\angle 3$ ?



*54° b/c alt.  
int.  $\angle$ s are  $\cong$*

3)

What are the values of the variables in quadrilateral  $MNOP$ ?



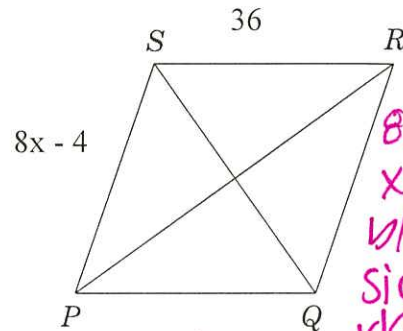
$$\begin{aligned} 6x - 8 &= 4x + 6 \\ 2x &= 14 \\ x &= 7 \end{aligned}$$

$$\begin{aligned} 5y + 16 + 4(7) + 6 &= 180 \\ 5y + 16 + 34 &= 180 \\ 5y + 50 &= 180 \\ 5y &= 130 \\ y &= 26 \end{aligned}$$

- (A)  $x = 4, y = 19$  (B)  $x = 6, y = 19$   
(C)  $x = 5, y = 27$  (D)  $x = 3, y = 32$   
(E)  $x = 7, y = 26$

4)

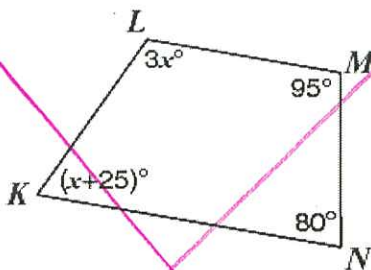
If  $PQRS$  is a rhombus, which statement must be true?



*8x - 4 = 36  
x = 5  
b/c all  
sides of  
rhombus  
are  $\cong$*

- a)  $x = 8$  b)  $x = -4$  (c)  $x = 5$  d)  $x = 36$

5)

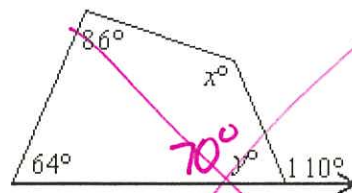


Given quadrilateral  $KLMN$ , what is the value of  $x$ ?

- A 35  
B 40  
C 45  
D 50

$$3x + x + 25 = 180$$

6) Find  $x$  and  $y$ .

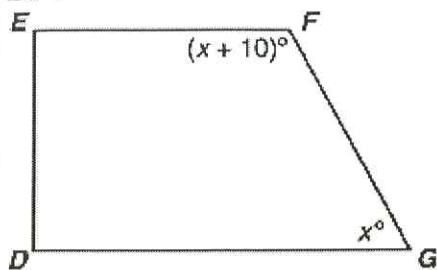


- A.  $x = 140, y = 70$   
B.  $x = 94, y = 70$   
C.  $x = 94, y = 20$   
D.  $x = 140, y = 20$

$$180 - 110 = 70$$



- 8) In Quadrilateral  $DEFG$  below,  $\overline{DG}$  is parallel to  $\overline{EF}$ .



a) What is the name of this quadrilateral? **Trap**

b) What is the measure of  $\angle F$ ?

$$x + 10 + x = 180$$

$$x = 85$$

$$\angle F = 85 + 10 = 95^\circ$$

89

The area  $A$  of a trapezoid can be found using the formula

$A = \frac{1}{2}(b_1 + b_2)h$ , where  $b_1$  and  $b_2$  are the lengths of the bases and  $h$  is the height. The area of a trapezoid is 54 square inches. If the length of one base is 11 inches and the height is 6 inches, what is the length of the other base?

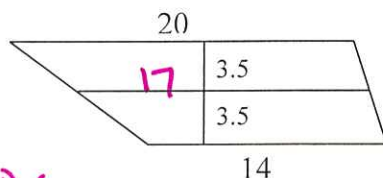
$$54 = \frac{1}{2}(11 + B)(6)$$

$$54 = 3(11 + B)$$

$$54 = 33 + 3B$$

$$B = 7 \text{ in}$$

9) Given:



$$(20 + 14)/2 = 17$$

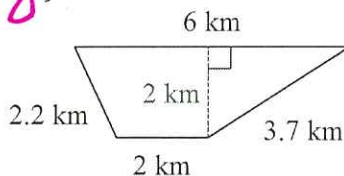
A. Determine the midsegment. **17**

B. Determine the area of the top trapezoid. **64.75**

C. Determine the area of the bottom trapezoid. **54.25**

E. Determine the area of the entire trapezoid. **119**

10) Find the area of the trapezoid below.



$$\frac{1}{2}(8 \times 2)$$

$$8 \text{ km}^2$$

11) The area of a trapezoid is  $55 \text{ cm}^2$ . If the length of the longer base is 12 inches and the height is 5 inches, what is the length of the shorter base?

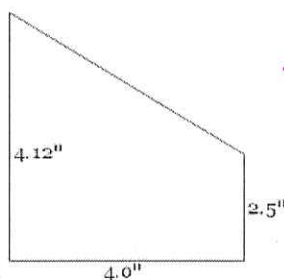
$$55 = \frac{1}{2}(12 + b)(5)$$

$$2.5(12 + b)$$

$$55 = 30 + 2.5b$$

$$b = 10 \text{ in}$$

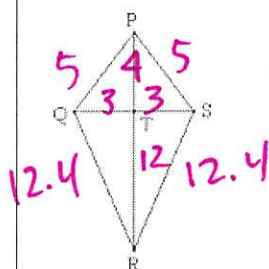
12) Find the area of the trapezoid below.



$$\frac{1}{2}(4.12 + 2.5)(4)$$

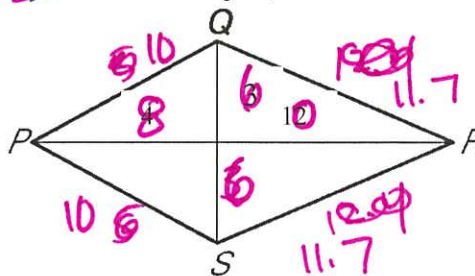
$$13.24 \text{ in}^2$$

13) In the kite below,  $PQ = 5 \text{ cm}$ ,  $PS = 5 \text{ cm}$ ,  $QS = 6 \text{ cm}$ , and  $TR = 12 \text{ cm}$ . What is the area of the kite?



$$3^2 + 12^2 = c^2$$

14) Given kite PQRS, find the following:

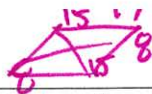


a) The perimeter.  $2(10) + 2(11.7) = 43.4$

b) The area.  $\frac{1}{2}(8 \times 12) = 48$   
 $\frac{1}{2}(10 \times 12) = 60$   
 $48 + 60 = 108$

PUSH IT TO THE LIMIT.

13



14

13) If one diagonal of a rhombus is 30 cm and the other is 16 cm, how long is each side of the rhombus?

14) If one diagonal of a square is 16 inches, find the length of one side of square?

a) Find the perimeter of the rhombus.

b) area:  $\frac{1}{2}(30)(16)$   
240

Find the perimeter of the square.

$4(8\sqrt{2}) = 45.3\text{ in}$

b) Area  $\frac{1}{2}(16)(16)$   
128

15

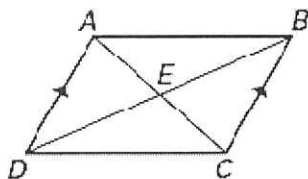
Multiple Choice Which additional piece of information do you need to prove  $ABCD$  is a parallelogram?

(A)  $\overline{AB} \cong \overline{DC}$

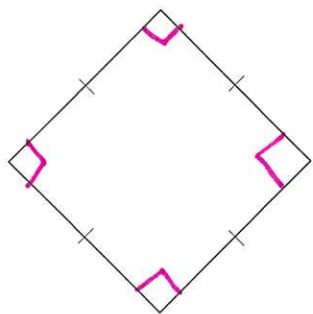
(B)  $\overline{AD} \cong \overline{BC}$

(C)  $\overline{AB} \parallel \overline{DC}$

(D) A or B



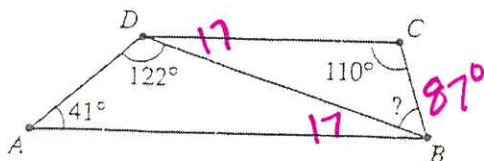
19) Judging by appearance, classify the figure in as many ways as possible.



- (A) rectangle, square, quadrilateral, parallelogram, rhombus  
 (B) rectangle, square, parallelogram  
 (C) rhombus, trapezoid, quadrilateral, square  
 (D) square, rectangle, quadrilateral

21

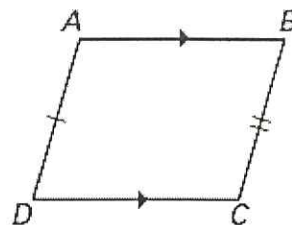
In the figure below,  $\overline{AB} \parallel \overline{DC}$ ,  $\angle A$  measures  $41^\circ$ ,  $\angle C$  measures  $110^\circ$ , and  $\angle ADB$  measures  $122^\circ$ . What is the measure of  $\angle CBD$ ?



20

Multiple Choice What kind of quadrilateral would meet the conditions of the diagram?  $ABCD$  is not drawn to scale.

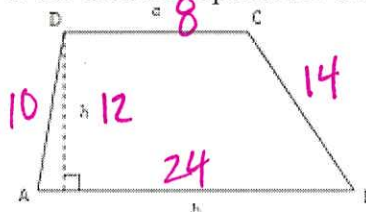
- (A) kite  
 (B) rhombus  
 (C) trapezoid  
 (D) square



only 1 pair of || sides

22

In trapezoid  $DCBA$  below, the  $h = 12$  cm,  $DC = 8$  cm,  $DA = 10$  cm,  $CB = 14$  cm, and  $AB = 24$  cm. What is the area of trapezoid  $DCBA$ ?

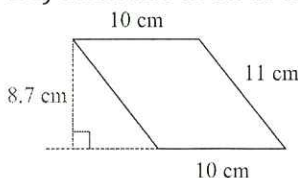


$\frac{1}{2}(8+24)(12)$   
192

23) Arkansas has a shape that is similar to a trapezoid with bases of about 182 miles and 267 miles and a height of about 254 miles. Estimate the area of the state.

$\frac{1}{2}(182+267)(254)$   
57023  $\text{mi}^2$

24) Find the area of the parallelogram:



$10(8.7)$   
87  $\text{cm}^2$